VERTEBRAL COLUMN

TOPOGRAPHIC LANDMARKS

1.) Cervical Region
- **C1 –** mastoid tip
- **C2-C3 –** gonion
- **C5 –** thyroid cartilage
- **C7 –** vertebral prominens

2.) Thoracic Region
- **T1 –** 2 in. superior to sternal notch
- **T2-T3 –** manubrial notch/superior margin of scapula/suprasternal notch
- **T4-T5** – sternal angle
- **T7 –** inferior angle of scapula
- **T9-T10** – xiphoid process/ensiform
- **T10** – xiphoid tip

3.) Lumbar Region
- **L3** – lower costal margin
- **L3-L4** – level of umbilicus
- **L4** – most superior aspect of iliac crest

4.) Sacrum & Pelvic Region
- **S1 –** ASIS
- **Coccyx –** pubic symphysis & greater trochanter

SPINAL CURVATURES

1.) Cervical & Lumbar Curve
- Convex anteriorly & concave posteriorly
- **Secondary/compensatory curve:** develop after birth
- **Cervical:** when baby starts holding the head
- **Lumbar:** when baby learns to walk

2.) Thoracic & Pelvic Curve
- Convex posterior & concave anteriorly
- **Primary curve:** present at birth

ABNORMAL CURVATURES

1.) Lordosis
- Exaggerated lumbar curvature
- Swayback
- Increase anterior convexity or posterior concavity

2.) Kyphosis
- Exaggerated thoracic curvature
- Humpback or hunchback
- Increase anterior concavity or posterior convexity

3.) Scoliosis
- Lateral curvature
- S-shaped

4.) Gibbus
- Posterior angulation of the spine

PATHOLOGY

1.) Clay Shoveler's Fx
- Avulsion fx of the spinous process in the lower cervical & upper thoracic region

2.) Compression Fx
- Fx that causes compaction of bone & a decrease in length or width

3.) Hangman's Fx
- Fx of the anterior arch of C2 due to hyperextension

4.) Jefferson's Fx
- Comminuted fx of the ring of C1

5.) Herniated Nucleus Pulposus
- Rupture or prolapsed of the nucleus pulposus into the spinal canal

6.) Kyphosis
- Abnormally increased convexity in the thoracic curvature

7.) Lordosis
- Abnormally increased concavity of the cervical & lumbar spine

8.) Osteopetrosis
- Increased density of atypically soft bone

9.) Osteoporosis
- Loss of bone density

10.) Scheuerrmann's Disease
- Adolescent kyphosis
- Kyphosis with onset in adolescence

VERTEBRAL COLUMN

11.) Scoliosis
- Lateral deviation of the spine with possible vertebral rotation

12.) Spina Bifida
- Failure of the posterior encasement of the spinal cord to close

13.) Spondylolisthesis
- Forward displacement of a vertebra over a lower vertebra, usually L5-S1

14.) Spondylolysis
- Separation of the pars interarticularis

15.) Odontoid Fx
- Disruption of the arches of C1

16.) Teardrop Burst Fx
- Comminuted vertebral body with triangular fragments avulsed from anteroposterior border caused by compression with hyperflexion in the cervical region

17.) Transitional Vertebra
- It occurs when the vertebra takes on a characteristic of the adjacent region of the spine

18.) Chance Fx
- Fx through the vertebral body caused by hyperflexion force

19.) Whiplash Injury
- Damage to the ligaments, vertebrae or spinal cord caused by sudden jerking back of the head & neck

A.) ATLANTO-OCCIPITAL JOINTS

AP OBLIQUE PROJECTION
R & L head rotations

PP: Supine; head rotated 45-60^{o} away from side of interest; IOML ⊥ to IR
RP: 1 in. anterior to the EAM
CR: ⊥
SS: Atlanto-occipital joints b/n orbit & ramus of mandible
- Dens is well demonstrated

ER: Alternative projection when a patient cannot be adjusted in the open-mouth position

B.) DENS

FUCHS METHOD
AP PROJECTION

PP: Supine; chin extended; chin tip & mastoid tip ⊥ to IR; MSP ⊥ to IR
RP: Distal to chin tip
CR: ⊥
SS: Dens w/in foramen magnums
ER: Recommended when upper half of dens is not clearly shown in open-mouth position

KASABACH METHOD
AP AXIAL OBLIQUE PROJECTION
R & L head rotations

PP: Supine; head rotated 40-45^{o}; IOML ⊥
RP: Midway b/n outer canthus & EAM
CR: 10-15^{o} caudad
SS: Dens
ER: Recommended in conjuction with AP & lateral projections

C. ATLAS (C1) & AXIS (C2)

ALBERS-SCHOBERG & GEORGE METHOD
AP "OPEN-MOUTH" PROJECTION

PP: Supine; MSP ⊥**;** open mouth as wide as possible;
RP: Midpoint of open mouth
CR: ⊥
SS: Atlas & axis

LATERAL PROJECTION

PP: Supine (dorsal decubitus); IR vertical; MSP // to IR; MSP ⊥ to table; neck slightly extended (mandibular rami does not overlap atlas or axis)
RP: 1 in. distal to mastoid tip
CR: ⊥
SS: Atlas & axis; atlanto-occipital joints

VERTEBRAL COLUMN

Pancoast, Pendergrass & Schaeffer
Recommendation:

- Head rotated slightly
- **Rationale:** to prevent superimposition of laminae & atlas

D.) CERVICAL VERTERBRAE

AP AXIAL PROJECTION

PP: Supine/upright; chin extended; occlusal plane ⊥ to IR (prevents superimposition of mandible & midcervical vertebrae)
RP: C4
CR: 15-20^{o} cephalad
SS: C3-T2

- Interpediculate spaces
- IV disk spaces
- Superimposed transverse & articular processes

ER: Used to demonstrate the presence or absence of cervical ribs

GRANDY METHOD
LATERAL PROJECTION

PP: Seated/upright; patient in true lateral position; shoulder rotated posteriorly or anteriorly (round shouldered); chin slightly elevated (prevents superimposition of mandibular rami & spine); MSP // to IR
RP: C4
CR: Horizontal
SS: C1-C7

- Articular pillars
- Zygapophyseal joints (C3-C7)
- Spinous processes

LATERAL PROJECTION
Hyperflexion & Hyperextension

PP: Seated/upright; patient in true lateral position; MSP // to IR

- **Hyperflexion:** head drop forward; draw chin as close as possible to the chest
- **Hyperextension:** chin elevated as much as possible

RP: C4
CR: Horizontal
SS: IV disks & zygapophyseal joints
SS in Hyperflexion:

- C1-C7
- Elevated & widely separated spinous processes

SS in Hyperextension:

- C1-C7
- Depressed spinous processes

ER:

- For functional studies (motility) of cervical vertebrae
- To demonstrate normal AP movement or absence of movement

AP AXIAL OBLIQUE PROJECTION

Barsony & Koppenstein: described this projection
PP: Supine or upright (more comfortable); RPO/LPO; body rotated 45^{o}; chin protruded/elevated
RP: C4
CR: 15-20^{o} cephalad
SS: Intervertebral foramina & pedicles (farthest from IR)
Boylston Suggestion:

- Functional studies in oblique projection
- **Rationale:** to demonstrate fx of articular process dislocation/subluxation

PA AXIAL OBLIQUE PROJECTION

PP: Prone or upright (more comfortable); RAO/LAO; body rotated 45^{o}; shoulder rested against IR; chin protruded/elevated
RP: C4
CR: 15-20^{o} caudad

VERTEBRAL COLUMN

SS: Intervertebral foramina & pedicles (closest to IR)

OTTONELLO/CHEWING/WAGGING JAW METHOD
AP PROJECTION

PP: Supine; MSP ⊥ to IR; chin elevated; upper incisors & mastoid tips ⊥ to IR; mandible in chewing motion during exposure
RP: C4
CR: ⊥
SS: Entire cervical column
ER: To blurred the mandibular shadow to demonstrate all cervical vertebrae

VERTEBRAL ARCH/PILLAR/LATERAL MASS PROJECTION
AP AXIAL PROJECTION

PP: Supine; shoulder depressed; MSP ⊥ to IR; neck hyperextended;
RP: C7
CR: 25^{o} caudad; 20-30^{o} caudad (range)
SS: Vertebral arch structures

- Superior & inferior articular processes (pillars)
- Zygapophyseal joints b/n articular processes
- Upper three of thoracic vertebrae
- Laminae
- Spinous processes

ER: Useful for demonstrating the cervicothoracic spinous processes in patients with whiplash injury

VERTEBRAL ARCH/PILLAR/LATERAL MASS PROJECTION
AP AXIAL PROJECTION

PP: Prone; head rested against IR; neck fully extended; MSP ⊥ to IR
RP: C7
CR: 40^{o} cephalad; 35-45^{o} cephalad (range)
SS: Vertebral arch structures

VERTEBRAL ARCH/PILLAR/LATERAL MASS PROJECTION
AP AXIAL OBLIQUE PROJECTION
R & L head rotations

PP: Supine; head rotated 45-50^{o} (C2-C7 articular processes) or 60-70^{o} (C6-T4 articular processes); turn jaw away from side of interest;
RP: C7
CR: 35^{o} caudad; 30-40^{o} caudad (ranges)
SS: Vertebral arch structures
ER: Used to demonstrate vertebral arches when the patient cannot hyperextend head for AP/PA axial projection

TWINNING & PAWLOW METHOD
SWIMMER'S TECHNIQUE
LATERAL PROJECTION

PP: Humeral head moved anteriorly or posteriorly; depress shoulder away from IR; MSP // to IR; breathing technque

- **Lateral recumbent (Pawlow):** head elevated on patient's arm;
- **Upright (Twinning):** arm closes to IR extended; elbow flexed; forearm rested on head

RP: C7-T1 interspace
CR: ⊥ (shoulder well depressed); 3-5^{o} caudad (can't be depressed sufficiently)
SS: Cervicothoracic region (C7-T1)
ER: Performed when shoulder superimposition obscures C7 on a lateral cervical spine projection
Monda Recommendation:

- CR 5-15^{o} cephalad
- To better demonstrate IV disk spaces

E.) THORACIC VERTEBRAE

AP PROJECTION

PP: Supine/upright; MSP ⊥ to IR; hips & knees flexed (to reduce kyphosis); place support under knees

VERTEBRAL COLUMN

RP: T7 (b/n jugular notch & xiphoid process)
CR: ⊥
SS: T1-T12

- IV disk spaces
- Transverse processes
- Costovertebral articulation

LATERAL PROJECTION

PP: Lateral recumbent or upright (Oppenheimer); left side against the table (places heart closer to IR) MSP // to IR; hips & knees flexed; arms at right angle to body (to elevate ribs enough); place support under lower thoracic spine
RP: T7
CR: ⊥ (w/ support); 10-15^{o} cephalad (w/o support); 10^{o} (female) or 15^{o} (male)
SS: T1-T12

- IV disk spaces
- Intervertebral foramina
- Lower spinous processes

FUCHS METHOD
AP OBLIQUE PROJECTION

PP: Supine/upright; RPO/LPO; body rotated 20^{o} posteriorly; MCP 70^{o} from IR
RP: T7
CR: ⊥
SS: Zygapophyseal/apophyseal joints (farthest from IR)

OPPENHEIMER METHOD
PA OBLIQUE PROJECTION

PP: Prone/upright; RAO/LAO; body rotated 20^{o} anteriorly; MCP 70^{o} from IR
RP: T7
CR: ⊥
SS: Zygapophyseal/apophyseal joints (closest to IR)

F.) LUMBAR-LUMBOSACRAL VERTEBRAE

AP PROJECTION

PP: Supine/upright; elbow flexed; hands on upper chest

- Hips & knees flexed
  - Reduces lumbar lordosis
  - Places back in contact w/ table
  - Reduces distortion of vertebral bodies
  - Better delineation of IV disk

RP: L4 (for lumbosacral); L3 (for lumbar spine only)
CR: ⊥
SS: Lumbar bodies

- IV disk spaces
- Interpediculate spaces
- Laminae
- Spinous & transverse processes
- Sacrum, coccyx & pelvic bones (larger IR)

LATERAL PROJECTION

PP: Lateral recumbent or upright; affected side against IR; hips & knees flexed; MCP ⊥ to IR; place support under lower thorax (places spine in true horizontal position)
RP: L4 (for lumbosacral); L3 (for lumbar spine only)
CR: ⊥ (w/ support); 5-8^{o} caudad (w/o support); 5^{o} (male) or 8^{o} (female)
SS: Intervertebral foramina of L1-L4 only; L5 intervertebral foramina (Oblique Projection)

F.) L5-S1 LUMBOSCRAL JUNCTION

LATERAL PROJECTION

PP: Lateral recumbent or upright; affected side against IR; hips & knees flexed; MCP ⊥ to IR; place support under lower thorax (places spine in true horizontal position)

VERTEBRAL COLUMN

RP: 2 in. posterior to ASIS & 1.5 in. inferior to iliac crest
CR: ⊥ (w/ support); 5-8^{o} caudad (w/o support); 5^{o} (male) or 8^{o} (female)
SS: Lumbosacral junction

G.) ZYGAPOPHYSEAL JOINTS

AP OBLIQUE PROJECTION

PP: Semisupine/upright; RPO/LPO; body rotated 45^{o} or 60^{o} (L5-S1 zygapophyseal joints & articular processes);
RP:
Lumbar region: 2 in. medial to elevated ASIS & 1.5 in. superior to iliac crest (L3)
5th zygapophyseal joint: 2 in. medial to elevated ASIS & midway b/n iliac crest & ASIS
CR: ⊥
SS: Zygapophyseal/apophyseal joints (closest to IR)

- Scottie dog
    - Superior articular process (ear)
    - Transverse process (nose)
    - Pedicle (eye)
    - Part interarticularis (neck)
    - Lamina (body)
    - Inferior articular process (foot)

Note:

- Majority (L3-S1) of zygapophyseal joints (45^{o} body rotation)
- L1-L2 & L2-L3 (AP; 25% only)
- L4-L5 & L5-S1 (LATERAL; small %age)

PA OBLIQUE PROJECTION

PP: Semiprone/upright; RAO/LAO; body rotated 45^{o} or 60^{o} (L5-S1 zygapophyseal joints & articular processes)
RP: 1.5 in. superior to iliac crest & 2 in. lateral to palpable spinous process
CR: ⊥
SS: Zygapophyseal/apophyseal joints (farthest from IR)

- Scottie dog

H.) LUMBOSACRAL JOINTS & SACRAL JOINTS

FERGUSON METHOD
AP AXIAL PROJECTION

PP: Supine; lower limb extended; thigh abducted;
RP: 1.5 in. superior to pubic symphysis
CR: 45^{o} cephalad (Ferguson); 30-35^{o} cephalad; 30^{o} (male) or 35^{o} (female);
SS: Lumbosacral joint; symmetric sacroiliac joints
Meese Recommendation:

- **PP:** Prone (places sacroiliac joints nearly // to CR)
- **RP:** 2 in. distal to L5 (level of ASISs)
- **CR:** ⊥

FERGUSON METHOD
PA AXIAL PROJECTION

PP: Prone
RP: L4
CR: 35^{o} caudad
SS: Lumbosacral joint; symmetric sacroiliac joints

I.) SACROILIAC JOINTS

AP OBLIQUE PROJECTION

PP: Semisupine; RPO/LPO; body rotated 25-30^{o}
RP: 1 in. medial to elevated ASIS
CR: ⊥
SS: Sacroiliac joint (farthest from IR)

AP AXIAL OBLIQUE PROJECTION

PP: Semisupine; RPO/LPO; body rotated 25-30^{o}
RP: 1 in. distal to elevated ASIS
CR: 20-25^{o} cephalad
SS: Sacroiliac joint (farthest from IR)

PA OBLIQUE PROJECTION

PP: Semiprone; RAO/LAO; body rotated 25-30^{o}
RP: 1 in. medial to elevated ASIS
CR: ⊥
SS: Sacroiliac joint (closest to IR)

VERTEBRAL COLUMN

J.) PUBIC SYMPHYSIS

CHAMBERLAIN METHOD
PA PROJECTION

PP: Upright; standing on two blocks

- **First exposure:** remove one blocks; one leg hangs with no muscular resistance
- **Second exposure:** replace support under foot that was hanging; remove the opposite one**;** second leg hanging free

RP: Pubic symphysis
CR: ⊥
SS: Pubic symphysis
Chamberlain Recommendations:

- For abnormal sacroiliac motion
- **Lateral Projection:**
  - Upright
  - Centered to lumbosacral junction
- **2 PA Projections of Pubic bones:**
  - Upright
  - Weight-bearing on alternate limbs
  - To demonstrate pubic symphysis reaction by a change in the normal relation of pubic bones

K.) SACRUM

AP/PA AXIAL PROJECTION

PP: Supine or prone (patient w/ painful injury/destructive disease)
RP: 2 in. superior to pubic symphysis (supine); visible sacral curve (prone)
CR: 15^{o} cephalad (supine); 15^{o} caudad (prone)
SS: Sacrum free of foreshortening

LATERAL PROJECTION

PP: Lateral recumbent; interiliac plane ⊥ to IR; pelvis & shoulder in true lateral position
RP: 3.5 in. posterior to ASIS
CR: ⊥
SS: Sacrum

L.) COCCYX

AP/PA AXIAL PROJECTION

PP: Supine or prone (patient w/ painful injury/destructive disease)
RP: 2 in. superior to pubic symphysis (supine); Palpable coccyx (prone)
CR: 10^{o} caudad (supine); 10^{o} cephalad (prone)
SS: Coccyx free of superimposition

LATERAL PROJECTION

PP: Lateral recumbent; interiliac plane ⊥ to IR; pelvis & shoulder in true lateral position
RP: 3.5 in. posterior & 2 in. inferior to ASIS
CR: ⊥
SS: Coccyx

M.) LUMBAR INTERVERTEBRAL DISKS

WEIGHT-BEARING METHOD
PA PROJECTION

PP: Upright; patient bending to right & left; lean directly lateral as far as possible
RP: L3
CR: 15-20^{o} caudad
SS: Lower thoracic & lumbar region
ER: Perform for demonstration of the mobility of intervertebral joints
Duncan & Hoen Recommendation:

- PA projection be used
- **Rationale:** IV disks more nearly // to CR

☺ THE END ☺

"BOARD EXAM is a matter of PREPARATION. If you FAIL to prepare, you PREPARE to fail"
03/31/14

VERTEBRAL COLUMN

RULES OF OBLIQUE				
Anatomy of Interest	**Projection**	**Position/Degrees**	**Structure Shown**	**Central Ray**
CERVICAL (Intervertebral Foramina)	AP Oblique	LPO – 45^{o} RPO – 45^{o}	Right IF (side up) Left IF (side up)	15-20^{o} cephalad 15-20^{o} cephalad
	PA Oblique	LAO – 45^{o} RAO – 45^{o}	Left IF (side down) Right IF (side down)	15-20^{o} caudad 15-20^{o} caudad
THORACIC (Zygapophyseal Joints)	AP Oblique	LPO – 70^{o} RPO – 70^{o}	Right ZJ (joints up) Left ZJ (joints up)	⊥ ⊥
	PA Oblique	LAO – 70^{o} RAO – 70^{o}	Left ZJ (joints down) Right ZJ (joints down)	⊥ ⊥
LUMBAR (Zygapophyseal Joints)	AP Oblique	LPO – 45^{o} RPO – 45^{o}	Left ZJ (joints down) Right ZJ (joints down)	⊥ ⊥
	PA Oblique	LAO – 45^{o} RAO – 45^{o}	Right ZJ (joints up) Left ZJ (joints up)	⊥ ⊥
SACROILIAC JOINTS	AP Oblique	LPO – 25-30^{o} RPO – 25-30^{o}	Right SIJ (joint up) Left SIJ (joint up)	⊥ ⊥
	PA Oblique	LAO – 25-30^{o} RAO – 25-30^{o}	Left SIJ (joint down) Right SIJ (joint down)	⊥ ⊥
AXILLIARY RIBS	AP Oblique	LPO – 45^{o} RPO – 45^{o}	Left AR (side down) Right AR (side down)	⊥ ⊥
	PA Oblique	LAO – 45^{o} RAO – 45^{o}	Right AR (side up) Left AR (side up)	⊥ ⊥

ANATOMY	**ZYGAPOPHYSEAL JOINTS**	**INTERVERTEBRAL FORAMINA**
Cervical	Lateral	Oblique – 45^{o}
Thoracic	Oblique – 70^{o}	Lateral
Lumbar	Oblique – 45^{o}	Lateral